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ABSTRACT

The College of Engineering and Computer Science at Wright State University implemented its first summer pre-engineering program in 1988 to increase the number of minority students from the area who graduate from high school with sufficient interest and academic preparation to successfully pursue engineering or some other science- or mathematics-based career at the college or university level. The 5-week program for students in Grades 7-10 includes mathematics, logic, problem-solving, computer science, an introduction to engineering, and such non-academic components as role models, academic motivation and enrichment, career awareness, study skills development, field trips and tours, and physical activities. Participating partners are the university, the Dayton Public Schools, the Aeronautical Systems Division, and industry. The university provided initial funding and will seek outside funding for continuation and expansion. The program begins with a maximum of 40 students and will expand to include about 200 from the Dayton area. (Author/MSE)

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WRIGHT STEPP
(Wright State University Engineering Preparatory Program)

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AASCU/ERIC Model Programs Inventory Project

The AASCU/ERIC Model Programs Inventory is a two-year project seeking to establish and test a model system for collecting and disseminating information on model programs at AASCU-member institutions--375 of the public four-year colleges and universities in the United States.

The four objectives of the project are:

- o To increase the information on model programs available to all institutions through the ERIC system
- o To encourage the use of the ERIC system by AASCU institutions
- o To improve AASCU's ability to know about, and share information on, activities at member institutions, and
- o To test a model for collaboration with ERIC that other national organizations might adopt.

The AASCU/ERIC Model Programs Inventory Project is funded with a grant from the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education at The George Washington University.

WRIGHT STATE ENGINEERING PREPARATION PROGRAM (WRIGHT STEPP)

The College of Engineering and Computer Science implemented its first summer pre-engineering program in 1988. The goal of WRIGHT STEPP is to increase the number of minority students from the Dayton area who graduate from high school with sufficient interest and adequate academic preparation to successfully pursue the study of engineering or some other science/mathematics based career at the four year college or university level.

OBJECTIVES

The objectives of WRIGHT STEPP are:

- to identify, recruit and select a cadre of minority students who demonstrate the potential for success in engineering,
- to increase the students awareness of career options for engineers and applied scientists,
- to motivate and increase the cognitive skills of students in the pursuit of careers in engineering and science,
- to provide student access to and interaction with successful role models from industry and education who serve the program in the capacity of speakers, instructors, tour guides, counselors and mentors,
- to demonstrate the realities of the workplace by providing tours and other local industry experiences,
- to provide certain "hands-on" laboratory experiences and academic instruction similar to what they will encounter in the first year of engineering study,
- to provide educational enrichment opportunities, and
- to encourage completion of the college preparatory track courses in the public school system.

RECRUITMENT

The target group for WRIGHT STEPP is the minority 7th through 10th grade students in Dayton schools. Forty (40) students (all 7th grade) were selected for the initial summer's program.

PROGRAM LENGTH/SCHEDULE

The five-week program will be conducted on the campus of Wright State University. Students will be on campus from 8:30 AM to 2:30 PM Monday through Friday, except for July 4th.

PROGRAM CONTENT

WRIGHT STEPP will include the following components:

- Logic and applications to mathematics
- Problem solving topics
- Role models
- Computer Science Introduction
- Mathematics (Algebra, Geometry, Trigonometry)
- Academic motivation/enrichment
- Career opportunities awareness
- Study skills development
- Field trips/tours
- Introduction to engineering
- Physical activities

EVALUATION

The final evaluation of this program will be indicated by the increased enrollment and success of program participants in engineering and science based curricula at the undergraduate and graduate levels. Student performance will be evaluated on the basis of demonstration of heightened preparedness to pursue the study of engineering or some mathematics/science based field as measured by their enrollment in and completion of a college preparatory course of study appropriate for or in advance of their individual grade levels.

PARTICIPATION

The participating partners in WRIGHT STEPP are:

- Wright State University (administration, teaching, role models)
- Dayton Public Schools
- Aeronautical Systems Division (role models, tours, teachers, mentors)
- Industry (tours, role models)

The 1988 funding was provided by Wright State University. Beginning in 1989 additional funding will be sought through funded proposals.

Beginning with no more than forty (40) students from the Dayton Public Schools in 1988, the program will grow to some higher projected level (approximately 200) from schools in the Dayton area served by Wright State University.

ABSTRACT

The decreasing interest in mathematics and science by U.S. high school students, the poor performance of U.S. high school seniors in international mathematics and science competition and the continuing shortage of American citizens entering the engineering and science professional fields as educators or practitioners are cause for concern in the U.S. today.

Unless some intervention action is taken to change the trends described above, there will be increasingly more serious consequences in the technological facet of American life and endeavor after the 21st century begins.

Changing demographics indicate that some eighty-five percent of the entering workforce during the next two decades will be women and minorities. Minorities and women have historically been underrepresented in engineering and science and must now be more numerically involved in these professions if our problems are to be controlled.

The academic, sociological and psychological preparation for success in science and technology curricula and careers must begin before high school. This paper describes a program designed to prepare students for a career in engineering or science but which will benefit any college bound student.

INTRODUCTION

This paper describes a program which addresses the shortage of engineers and scientists which the United States has experienced for the past decade and which is predicted to worsen during the next two decades. The pre-College intervention program described in this paper is intended to decrease the degree of the shortage and, if implemented by enough engineering schools in the United States early in the 1990's, to alleviate the shortages.

The approach and philosophy of the WRIGHT STEPP is somewhat unusual but not totally unique or original. The processes of student selection, teacher selection and course presentation are not necessarily conventional but tend to be more effective for the students involved in the program.

A critical component of the program is the volunteer teaching assistant cadre from local Federal Government and military installations.

There are two phases to the program, both of which must be successfully completed to receive the tuition scholarship offered to attendees. These are the

five-week, on-campus summer intensive study phase and the school year regular classroom phase.

The evaluation, tracking and success indicators are described. .

BACKGROUND

It is generally agreed that American education—and engineering and science education, specifically, faces serious problems of great magnitude. Data supporting this statement has already been collected, studied, confirmed and is readily available. The indications are that in the United States:

- The number of White males that traditionally pursue science and engineering is decreasing
- Fewer students indicate an interest in science and engineering
- The increase in minorities and women studying science and engineering has ceased
- The influx of foreign nationals who remain in the U.S. to work may cease as their native countries become more prosperous and there are good jobs for them at home
- Since physics and math students are decreasing, there will be fewer in these disciplines to fill the gap in times of shortages
- The percentage of native U.S. students in physical sciences and engineering continues to decrease (55% of engineering Ph.D's go to foreign nationals)
- Engineering and science faculty are increasingly foreign born

At the Ph.D level, there will be a shortage across the board, especially in native born Americans. This will be exacerbated by large numbers of retirements at academic institutions which will surge in the mid 1990's. The minority population is increasing while the white population is decreasing. By 2020 current minorities will make up 50% of the population and by 2000, only 15% of new workers will be white males. Except Asians, minority groups are grossly under represented in science and engineering and also experience broad based educational difficulties which they must overcome to increase participation in technological fields. This will take massive—and successful—interventions! Experts agree that such intervention must occur before high school—preferably no later than seventh grade.

This means we must start immediately if we want to impact who will complete engineering and science degrees in the year 2000. For minorities factors which must be overcome include—but are not necessarily limited to:

- Poverty and cultural prejudice against academic achievement for African-Americans
- Poor academic counseling and preparation
- Too few role models (only 2.6 percent of the African-American population are scientists and engineers. In 1988 only 59 African-Americans, Hispanics and native Americans earned a Ph.D in engineering while 1,441 foreign nationals did)
- Reduced college attendance rates
- Less family financial support for college
- Higher unemployment rates for minority scientists and lower salaries as compared to white males

The U.S. educational system is failing to provide adequate quantitative education not only for minorities and females, but for the entire student population. Our students do poorly in international testing. Few U.S. high schools now require four years of science or math. Federally funded fellowships had fallen from 60,000 in 1970 to less than 13,000 in 1986. Out of 10,000 high school sophomores, only 20 will earn a Ph.D in science or engineering.

As dismal as it may be, the situation can be corrected. The solutions will require massive, concerted efforts involving all community sectors, education, business, and society as a whole.

DESCRIPTION

The WRIGHT STEPP initiative is intended to reverse the unfortunate trends mentioned above. The Wright State University (Dayton, Ohio) Engineering Preparatory Program (WRIGHT STEPP) was implemented in the summer of 1988. The inaugural class was forty (40) post seventh grade students from three intermediate schools in the Dayton Public School system. Students were transported to the Wright state campus for six weeks where they attended classes from 8:30 AM until 2:30 PM five days each week. The summer 1989 class included eighty (80) students, forty (40) post seventh graders and forty (40) post eighth graders from the same three Intermediate Schools. In 1990 forty (40) post ninth

grade students will be added. The summer of 1991 will see the full planned capacity enrollment when forty (40) post tenth graders will swell the group size to 160.

PROGRAM PHILOSOPHY

The goal of WRIGHT STEPP is to increase the number of high school minority graduates who are both academically prepared and sufficiently motivated to enter and successfully complete a four year college or university math/science based curriculum. The ultimate success of WRIGHT STEPP would be achieved if every participant graduated from college with a math/science based degree but if NONE would have gone to college at all—had it not been for WRIGHT STEPP. If the ultimate in success is to be approached, there must be participants selected who are not excelling academically but who will because of the intervention program.

WRIGHT STEPP seeks students who do have potential to do well in math and science and who have some aptitude and interest in engineering and science but who, for some reason, are not doing well enough academically to make them obvious recruitment targets for math and/or science based curricula. This is, perhaps, unique for programs sponsored by a university with the intent of later recruiting the participants into math/science based curricula. There are many programs which seek the very high performing student and provide an enrichment period which has a very strong "come to this college" message intentionally built in.

The WRIGHT STEPP messages are:

- a) Proficiency in high school math and science will prepare one for any college curriculum
- b) Math and science have endless application for each of us and they can be interesting
- c) If you do well in math, science and English, you should be able to handle any college program
- d) If you take the high school college prep courses and maintain a B average with no grade below C, you can get a scholarship at WSU's engineering school—and probably at any other state school in Ohio

It is anticipated that a number of the participants will accept the WSU scholarship offer because some will be space bound and will find options limited because of financial circumstances. The important consideration is that WRIGHT STEPP will cause more students to take the college prep course in high school; more will take those courses with a goal of grade "A" rather than "C"; more

will finish high school with a 3.+ Grade Point Average; and more will go to college than would have been the case without the program.

TEACHING TECHNIQUE

The teaching techniques for WRIGHT STEPP are different than those of the conventional classroom. The selection of the right teachers is just as important as the selection of the right students. The teacher and teaching assistants must:

- a) increase each student's interest in math and science so they will learn more from courses
- b) make courses interesting and challenging so students will want to continue in a math/science based curriculum
- c) create an interest in and curiosity about science and engineering so that students will consider such careers.

For each course there is a "lead teacher" who is in charge of the material to be covered in the course during the program. Each class has as many assistants as needed to implement the teaching technique. Whereas the normal classroom has a single teacher and a group of students, the WRIGHT STEPP classroom has as many as five assistants for twenty students.

The assistants are present so students do not have to wait for the teacher to answer their questions one at a time. Each student question is answered immediately and to the satisfaction of the student by an assistant. Students who need a lower level explanation can get such an explanation. Those students who grasp the material being taught – or those who already understand the material well can be taken one interesting and challenging step further by an assistant.

This procedure works well in cases where students from different schools have been taught slightly different materials and in different ways.

Teachers who contribute to the success of an intervention program such as WRIGHT STEPP should have certain attributes:

- a) A positive attitude toward math and science and the students
- b) A philosophy (belief) that where there is teaching, there will be learning and the realization that where there is no learning, there is no teaching
- c) An ability and willingness to communicate with students in ways that are relevant to students
- d) Patience to teach at the level of the students as individuals—not teach only at the level of the majority of the class

- e) The ability to entice each student to perform to the extent of his/her ability and just a bit more
- f) An ability to relate subject matter to the student's real world

SELECTION PROCEDURE

WRIGHT STEPP is designed so that there are only winners—no losers—resulting from participation. This requires a unique series of events and conditions which must be fulfilled by participants. The events which must be sequentially completed are discussed below. Success requires that the student have both the aptitude (potential to succeed) and the interest (desire to succeed) in a math/science based career.

1. Nomination

The potential and aptitude of an Intermediate School student should be known to that student's math teacher and science teacher. To be considered for WRIGHT STEPP, a student must be nominated by a math teacher and a science teacher. The nomination form has space for comments from the nominator.

2. Orientation

Nominated students and their parents are required to attend an orientation during which the program is explained in detail. Parents and students who have questions related to the program get answers. The reasons for the program, requirements of students with respect to attendance, discipline, class schedules and what is expected of students and parents are explained. The benefits of the program are also explained including the tuition scholarship available to students who successfully complete the summer session and maintain a B average with no grade lower than C in the College Prep curriculum the following school year.

3. Application

Those students who attended an orientation with their parents are eligible to apply for admission to WRIGHT STEPP. The application is jointly completed by student and parents. This "contract" is an agreement for support from the home for the student who will be in classes from 8:30 AM until 2:30 PM five days a week for five weeks. (The 1989 and later summer sessions will be five weeks in length). Parent support is needed to encourage students to attend even though their friends may be involved in "fun and games" or just "hanging out" during this period of the

summer and exert pressure to encourage participants to lose interest in WRIGHT STEPP.

- An essay, written by the student and indicating why s/he should be accepted into the program, is required as a part of the application. The essay must be 200 words long and be hand written.
- The student's grade report for the current school year is also provided by the school and included with the application.

4. Interview

All students completing items 1 thru 3 above are personally interviewed by the program director. Although only 5-10 minutes long, this interview session can be very informative after review of the previously submitted items.

5. Selection

After the interviews, forty students are selected from each grade and offers of acceptance as primary candidates are sent to them. The remaining applicants from each grade are ranked as alternates. Alternates are offered seats in the program when primary candidates decline to accept the program offer.

6. Acceptance

Students who accept the invitation to be a part of WRIGHT STEPP must return the acceptance statement (signed by student and parent) and the usual liability release statements.

7. Final Orientation and Registration

The final event prior to the beginning of classes is a Saturday orientation for students and parents. Students obtain ID cards, library cards, locker assignments and take campus tours while parents are familiarized with the campus, the classrooms for students, and the University in general.

Attendance at the final orientation is an indicator of which students will begin the program. There are those who decide not to participate for various reasons as the seven above events happen. Some who are nominated do not appear at the first Orientation session for various reasons. Some who attend the orientation do not apply.

A planned ten day family vacation trip or a week at summer camp or spending the summer out of state with the other parent are normal reasons for the

lack of application from some students. There are those students who realize that the program is not intended to be an entertainment function and opt, with parental approval, for a summer of fun and games instead.

THE SUMMER SESSION PHASE

The summer session is a five week commuter program. The students are on campus from 8:15 AM till 2:45 PM. Classes are scheduled from 8:30 AM to 2:30 PM. While on campus, they attend classes in pre-algebra, algebra, geometry, communications, introduction to computers and other classes which involve experiments and demonstrations of engineering and science phenomena. These latter courses are taught by a cadre of volunteer engineers and scientists from nearby Wright Patterson Air Force Base and the Defense Electronic Supply Center and are designated as Engineering Applications I and II, Engineering Seminar and Introduction to Engineering.

It is appropriate at this point to state that the contributions of the Federal Government military and civilian employees from these two agencies is most important. Without the generous cooperation of the installation commanders, the content and effectiveness of the program would be seriously compromised.

The summer session is rigorously structured to maximize the total benefit to the student. It is for this reason that the time spent on the campus is used for activities which can be obtained only on the campus. Aside from the unscheduled 20-30 minutes "free time" students have after lunch, there is no physical recreation activity on the schedule. This arrangement is not as tedious as it may at first appear because the Tuesday and Thursday schedules include only three formal class periods of 45 minutes each. The remainder of those days is devoted to a field trip and tour of a local engineering or scientific based industry which provides physical activity and interesting observations and personal involvement for students.

The schedule on other days has only two class periods of 45 minutes each which do not involve students in active participation. An activity such as an experiment or physical demonstration during which students are actually involved reading instruments or making dynamic observations from different and varying vantage points keeps interest high.

For the summer session a total of three staff personnel and seven lead teachers were involved. In addition to these, some 100 volunteer teaching assistants, role model speakers, tour guides and laboratory demonstration personnel contributed varying amounts of time supporting the program.

WRIGHT STEPP FACTS

	<u>1988</u>	<u>1989</u>
DATES:	20 June - 29 July	12 June - 15 July
WHO:	40 (7th graders)	40 (7th graders) 40 (8th graders)
FROM:	Fairport, Fairview, Kiser Intermediate Schools	
DEMOGRAPHICS:	16 M 24 F	38 M 42 F
COMPLETIONS:	35 (87.5%)	73 (91 %)
FUNDING:	Wright State University	Wright State University *Wright-Patterson AF Base *Defense Electronic Supply Center *Dayton Public Schools
VOLUNTEERS:		
*W-P AF Base	40	120
*DESC	2	8
*DPS	8	2
COURSES:	6	9
CLASS PERIODS:	145	140
CLASS HOURS:	126	105
FIELD TRIPS:	5	8
ROLE MODEL SPEAKERS:	16	15
*In-kind Services provided		

ACADEMIC YEAR PHASE

During the regular September to June academic year WRIGHT STEPP student participants are still in step with the program. One reason is the availability of a one year tuition scholarship to participants upon graduation from high school providing they have a "B" average with no grade below a "C" in a college preparatory curriculum during the academic year following their summer

participation. A student can get four such one year tuition scholarships if four years of participation are successfully completed.

Additional conditions of the tuition scholarships are that the student enroll in Wright State University within one year of graduation from high school and that a 2.5 GPA be maintained while attending Wright State.

RESULTS

The WRIGHT STEPP initiative is only two years old. Meaningful results will be available only after the inaugural class finishes high school, enrolls in college and graduates. There has been no attempt to quantitatively measure items. The successful completion of the summer session has been 87% and 91%, respectively for the first two years.

This program is intended to be continuing as long as it is needed. The time when it is not needed is not within the sight of the Director.

The evaluation of this program will include data on the increased enrollment of its participants in the college preparatory curricula in high school, the increased enrollment and success of participants in engineering and science programs at the College undergraduate and graduate levels.

There are some "results" which can be mentioned here and now. They are more qualitative than quantitative, but they are encouraging and rewarding to those who give of their time and energy. Some math and science teachers have noticed improvement in certain participants' study habits, quality of homework and general interest level. Some parents have been impressed by their child's changed attitude toward math, science and school, in general. During the summer '89 program, several parents volunteered to participate as monitors during industry tours, assist with in-class projects; and some merely came to follow their child through the day's schedule. The increased interest of parents in the education and learning of their children is considered very important by the Director.

CONCLUSIONS AND RECOMMENDATIONS

After the first two years operation, there are some observations which can be made which lead one to short term conclusions.

- Students are willing to attend academic classes during the summer when those sessions are made interesting and challenging.

- Many students who attended the 1988 summer session were reported, by their teachers, to be better students during the 1988-89 school year.
- Parents of many student participants have taken new interest in the academic life of their children.
- Some parents of participants have volunteered to assist in the summer sessions.
- Student participants have increased knowledge and interest in local industry and government engineering oriented companies as a result of role model speakers and field trips.
- Local Industry has greater interest in the educational process in the community.
- Beneficial partnerships are being formed involving local industry, government research installations, the Wright State University, the minority community, the Public school system, teachers in the school system and parents of student participants.

A pre-College intervention program similar to WRIGHT STEPP will benefit any community. Even if participating students do not enter the engineering or physical science career fields, they will have gained valuable preparation for college and success in any career field.

The synergistic effects of bringing together the partnerships to implement such a program are limited only by the imagination of the partners. Everyone wins by getting involved in "community" projects such as this.